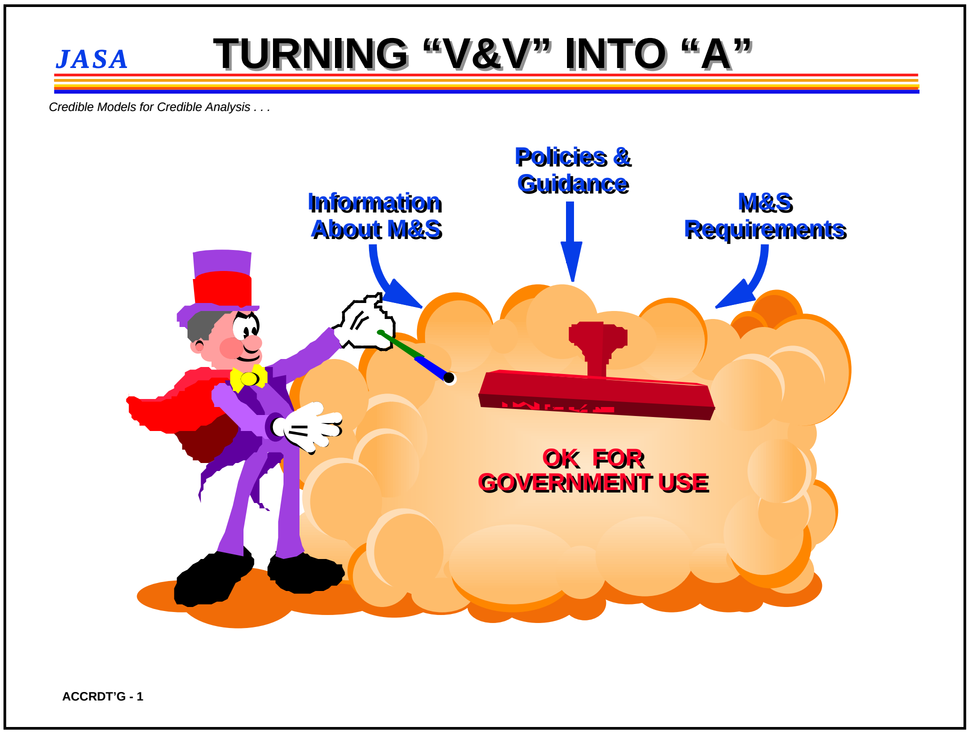
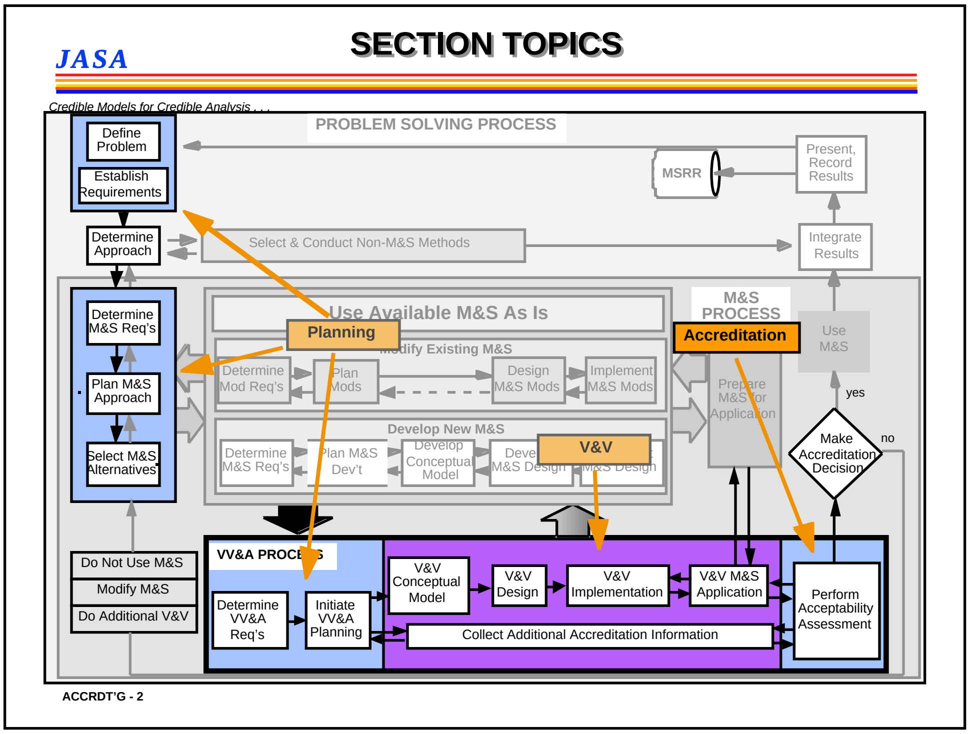


The previous sections covered the preparations and planning that must be done prior to starting any VV&A program and how to collect useful and appropriate V&V data to support accreditation. This section will cover the approach and techniques for actually assessing model suitability to justify an accreditation decision. As in previous sections, each of the detailed steps will not be described in detail. Rather, the important steps and the productive techniques that have been developed based on past experience will be described.

The common perception of accreditation is that all the available V&V data should be collected and presented to the accreditation official, generally a senior military person. That person, who obviously possesses great wisdom because of his or her exalted rank, should be able to assimilate all of this information, and using magical powers, make a decision that the model is suitable and can be accredited. This view is entirely fallacious. Despite the fact that most military officers are extremely capable, they are not magicians. Accreditation really must follow a logical thought process that leads to a conclusion about model suitability.



Referring back to the DMSO RPG chart that portrays the VV&A process, this section of the tutorial addresses the accreditation assessment step which leads to the accreditation decision. Since the decision itself is a single act of the accreditation authority, there is not much to discuss in that step. The difficult step is the evaluation of all the available information, in light of the requirements of the application, to arrive at a conclusion about the suitability of a model. To perform an adequate assessment of the V&V information it is necessary to refer back to our concept of what accreditation really means.

WHAT IS ACCREDITATION?

JASA

Credible Models for Credible Analysis . . .

THE OFFICIAL DETERMINATION THAT A MODEL OR SIMULATION IS SUITABLE FOR A PARTICULAR USE.

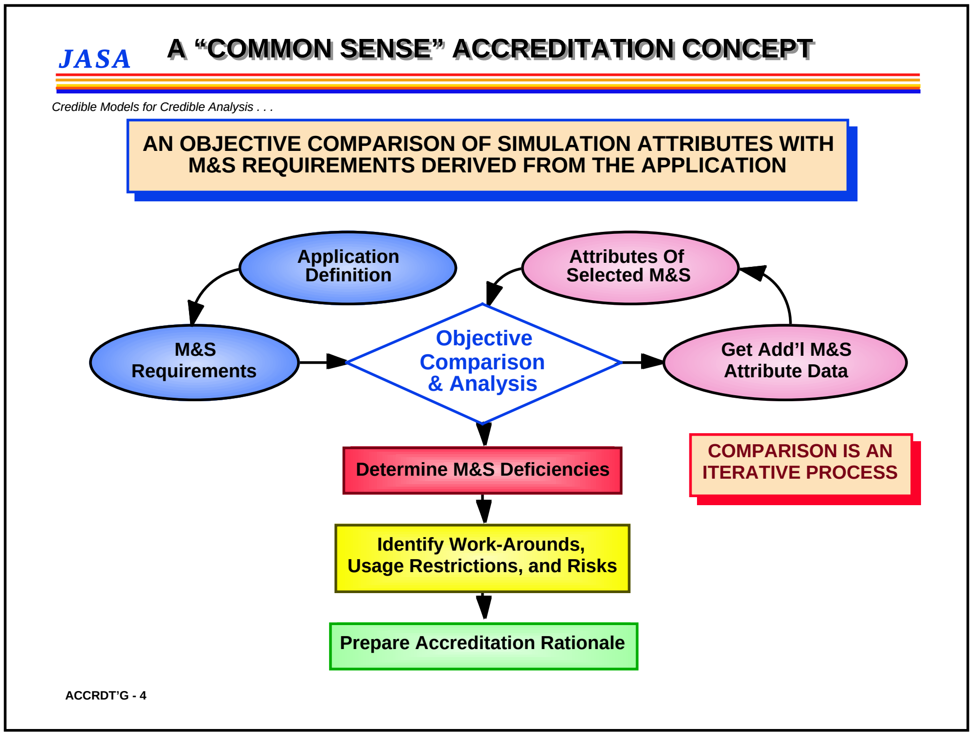
THIS MEANS

- **SIMULATION POSSESSES ALL REQUIRED CAPABILITY, CREDIBILITY, AND OPERATING CHARACTERISTICS; OR**
- **ACCEPTABLE WORK-AROUNDS HAVE BEEN IDENTIFIED FOR M&S DEFICIENCIES; OR**
- **RISKS ASSOCIATED WITH REMAINING DEFICIENCIES HAVE BEEN EVALUATED AS ACCEPTABLE**

ACCRDT'G - 3

As should be recalled, the official definition of accreditation is that a model or simulation has been determined to be suitable for a particular use and therefore officially approved for that use. In a practical sense, a model can be considered suitable if it meets one of three conditions. First, the model"s capabilities, its functional representations, its outputs and its accuracy fulfill all the requirements of the application. Second, the model may have some deficiencies but there are adequate work-arounds that can be used to compensate for these known deficiencies. Third, the model has some deficiencies for which there are no suitable work-arounds. However, the chances that these deficiencies will have a major impact on any decision that results from using the model are low and the risks associated with a decision based on information generated from this less-than-adequate model are considered acceptable.

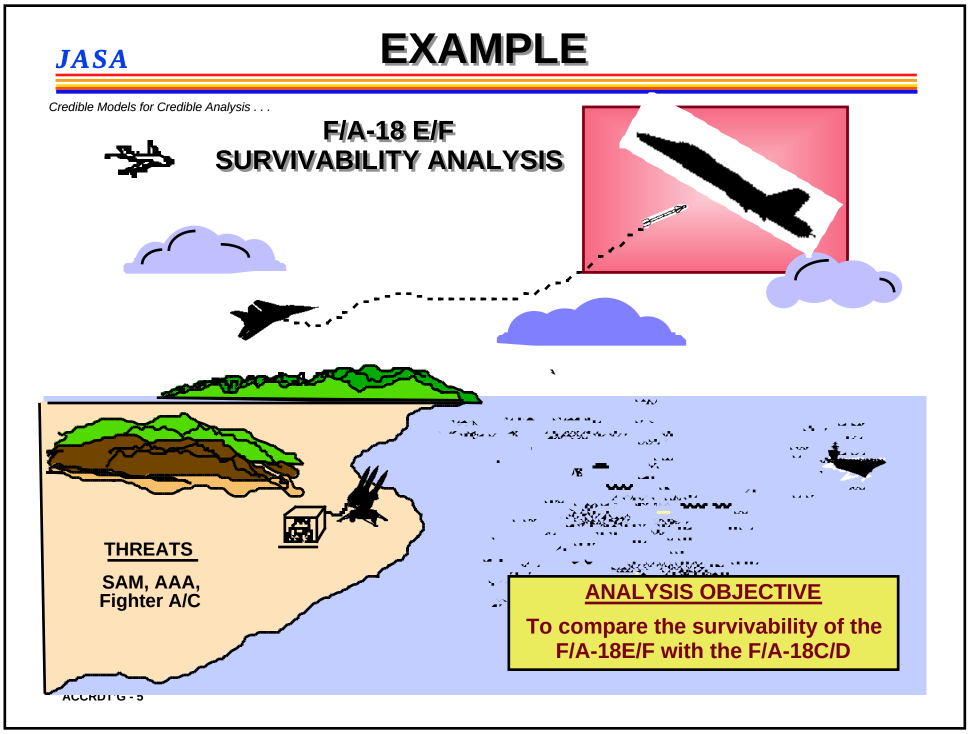
This understanding of what accreditation means is important for properly assessing a model's suitability and ultimately gaining accreditation of that model for a particular purpose.



Knowing what accreditation really is leads one to the realization that the key accreditation step is a comparison of a model's capabilities and attributes with the modeling requirements. To make this judgment about model adequacy, we must know the modeling requirements that result from the unique nature of the application. Thus, the importance of the preparatory steps, defining the problem and deriving the modeling requirements, should be readily apparent.

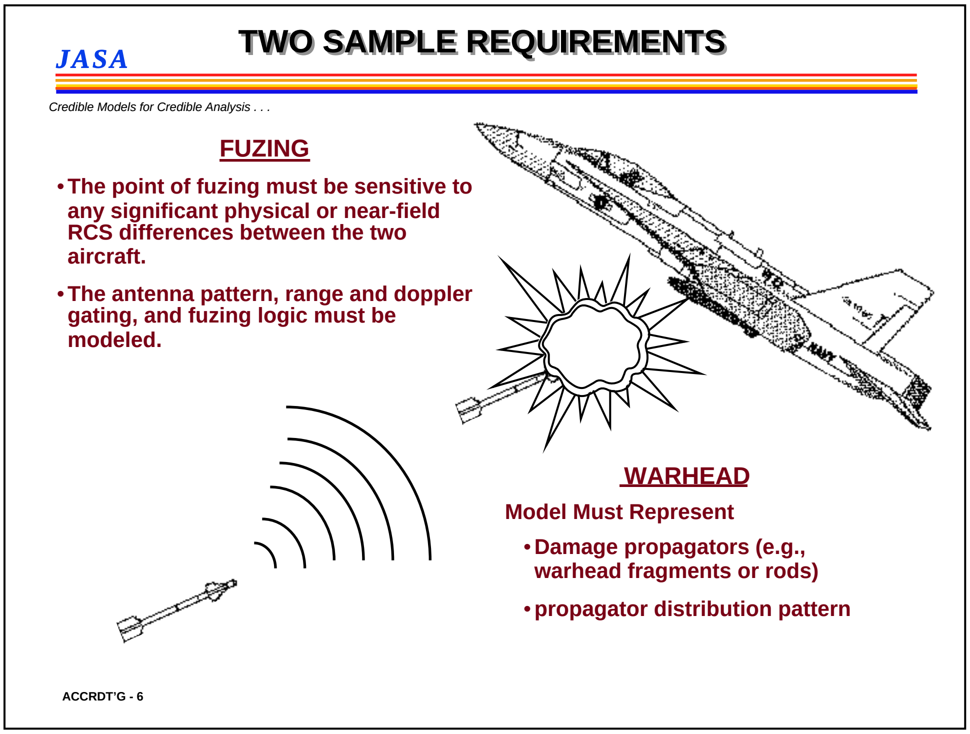
Besides the modeling requirements, the attributes and features of the model must also be known. These come from model documentation and well documented V&V results that highlight model capabilities, assumptions, and limitations. The comparison is usually an iterative process in that the first iteration leads to a list of information deficiencies about the model. Those information deficiencies lead to supplemental V&V work to generate information about particular features and model capabilities that need to be verified and/or validated. Once the supplemental V&V information has been generated, a final comparison can be made and a list of model deficiencies generated.

This list of model deficiencies is not the end product. The impact of these deficiencies on the problem analysis and on the expected problem outcome must be investigated. Work-arounds should be identified where feasible. Where there are no work-arounds, the risks of using the model as-is must be evaluated. Only with all these results can one come to a rational judgment about the suitability or acceptability of the model and thus generate reasonable justification for the accreditation decision.



To better understand this concept of how model suitability should be evaluated, one can look at an actual example of this comparison process. The F/A-18E/F program must demonstrate that the survivability of the F/A-18E is better than that of the F/A-18C. This type of demonstration cannot be done through system testing alone. Therefore, the program officials decided to use M&S to analyze the relative survivability parameters of the two aircraft. To be valid the analysis must cover all types of threat weapons (AAA, SAM, other aircraft, and detection systems).

As an example of the assessment process and how the comparisons were done, we will consider only a small part of the overall survivability comparison problem. We will look at the part of the problem that encompasses the missile fuzing and the warhead representation (the highlighted box in the slide).



In developing the modeling requirements for the fuzing part of the engagement, the analysts specified that the fuzing point must be sensitive to near-field RCS differences between the two F/A-18 versions. They also required that the antenna pattern, range and doppler gating and fuzing logic of the missile be modeled.

In specifying the warhead modeling requirements, they stated that the different types of damage propagators be modeled along with the propagator dispersal patterns. They developed these modeling requirements based on the type of analysis they intended to perform and on the metrics that were selected to quantify the survivability parameters.

JASA

FUZING ASSESSMENT

Credible Models for Credible Analysis . . .

- **MODEL CAPABILITIES**
  - > **Uses a simplified fuze antenna model (Stick/Cone model)**
  - > **Represents target as geometric shapes with predetermined glint points**
  - > **Assumes the probability of fuzing is always 1.0 within certain distances**

- **MODEL ASSESSMENT**
  - > **Simplified target representation cannot model RCS reductions around engine intakes of F/A-18E/F**
  - > **Fuze sensor would "see" other parts of aircraft (unchanged between "C" and "E") before seeing intakes**
  - > **Stick/Cone antenna representation is adequate for this analysis**
  - > **Assumption that missile will always fuze within certain minimum distances is OK for aircraft size targets**

ACCRDT'G - 7

The Joint Service Endgame Model (JSEM) was selected to represent the fuzing and endgame portions of the engagement analysis. JSEM calculates the fuzing point with basic geometric codes that rely on simple cone-like representations of the fuze sensory pattern intersecting a geometric target or predetermined glitter points on a target. This type of model works well enough in some cases. However, there are several problems associated with this approach. Perhaps the biggest problem is that within some predetermined fuze cut-off range the probability of fuzing P(F) [as assumed by the stick-cone model] is always one. For physically large and complex targets that assumption may not be critical. However, the assumption that P(F) = 1 for a "small" target may be a fatal simulation error. The fuzing factor [in the survivability equation] can vary from zero to one for small targets and can be the driving element in the P(K) calculation.

The original intent of the analysts was to use the simple stick/cone model representation for the comparative assessment. This approach was deemed adequate for the level of analysis being performed. However, some members of the assessment team pointed out that the reduction of RCS around the F/A-18E engine inlets would significantly change the response of the largest reflector the fuze would see, therefore the stick/cone representation would be inadequate. After some discussion, all team members acknowledged that it would be nearly impossible for a missile fuze to "look" at the engine inlets without first having encountered (and been activated by) other parts of the aircraft which were not significantly different between the -E and -C. Thus the consensus was that the use of the stick/cone fuze model was adequate for the F/A-18 comparison.

JASA

WARHEAD ASSESSMENT

Credible Models for Credible Analysis . . .

- **MODEL CAPABILITIES**
  - > **Component level vulnerability data on Expanding Rod Warheads are not available as inputs to this analysis**
- **MODEL ASSESSMENT**
  - > **Major deficiency**
- **ALTERNATIVES**
  - > **As a work-around, analysts will use a pattern of closely spaced fragments of appropriate size and weight to represent a continuous rod**
  - > **Work-around considered adequate for comparison purposes**

ACCRDT'G - 8

The types of warheads modeled by JSEM include: blast-fragmentation, naturally fragmenting, controlled fragmentation, discrete rods, azimuthally aimable versions of discrete rods, and continuous rods. However, there is a limitation on the available data. The component level vulnerability data needed to run this function is not available from COVART (or any other currently available vulnerability model). This deficiency is a major problem that impedes a valid survivability analysis.

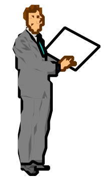
As a work-around, the endgame analysts plan on using a pattern of closely spaced fragments of appropriate size and weight to represent a continuous rod. The consensus was that this would be adequate for the F/A-18 comparison.

This example of a comparison of two requirements with the capabnilities of selected models should help clarify just what is done in assessing the suitability of a model for a particular use or application.

JASA

COMPARISON METHODS

Credible Models for Credible Analysis . . .



- **ONE PERSON REVIEW**
  - > **APPROPRIATE WHEN:**
    - » M&S Requirements are simple and specific
    - » Model structure and outputs are straight forward
  - > **REQUIRES INTELLECTUAL HONESTY**

- **EXPERT TEAM REVIEW**
  - > **APPROPRIATE WHEN:**
    - » M&S Requirements are broad or not clearly defined
    - » Model hierarchy is complex with low level model outputs providing inputs to higher level models
    - » Application Results are important or highly visible
  - > **REQUIRES TEAM MEMBERS WITH TECHNICAL COMPETENCE AND SUBJECT MATTER EXPERTISE**

ACCRDT'G - 9

After one understands the nature or an accreditation assessment, the next usual question is "How is the accreditation assessment done?" The accreditation assessment can take one of two forms depending on the complexity of the application and/or model. If the application is straight forward and the model simple, the assessment can be done by a single analyst. If either the model or the application is more complex, the need to include individuals with a variety of backgrounds becomes more important. For typical, complex applications an expert team is usually best suited to perform the review. Use of an expert team is also desirable when the visibility of the application requires unquestionable objectivity. This will be the case if the project is relatively large or politically sensitive.

Ideally, both methods should produce the same basic result. However, the latter approach is imbued with more credibility due to its greater perceived objectivity and less dependence on the technical expertise of a single individual.

JASA

2 KEYS TO A SUCCESSFUL REVIEW

Credible Models for Credible Analysis . . .

- **GOOD PLANNING**
  - > WELL-UNDERSTOOD REVIEW OBJECTIVE(S)
  - > CLEARLY DELINEATED REPORT EXPECTATIONS
  - > RIGHT REVIEWER(S)
  - > GOOD "READ-AHEAD" MATERIAL
    - » Summarizes (agreed upon) Objectives, Acceptance Criteria & Modeling Requirements
    - » Outlines M&S Capabilities
    - » Outlines report and lists team members

- **WELL-DIRECTED DELIBERATIONS**
  - > LIMITED TO M&S SUITABILITY DISCUSSIONS
  - > FULL-TIME MEMBER PARTICIPATION
  - > ADDRESSES RELATED ISSUES
    - » Input data, Analysts' qualifications
  - > GENERATES THE EXPECTED REPORT
    - » Identifies M&S Deficiencies
    - » Includes discussion of work-arounds, restrictions, & risks due to uncorrected deficiencies
    - » Explains rationale for accreditation

ACCRDT'G - 10

There are two primary factors that influence the success of any accreditation review: good planning and focused, well-disciplined deliberations.

Good planning for a review entails the development and promulgation of a clear set of review objectives to ensure that everyone clearly understands what is intended.

Good planning obviously includes selection of the review team. There are two general reasons for putting a person on the team: technical or political. Ideally, people should be selected based on technical rationale. Where political requirements must be met, selected individuals should, as a minimum, be technically capable of understanding the discussion to avoid disruptive, and time consuming basic explanations. During the review, the capabilities of the analysts using the model should be addressed as well as the adequacy and credibility of the sources for the input data.

Finally the intended product should be outlined as part of the planning process, even to the extent of developing a report outline that is missing only the critical judgments about model suitability. Such an outline will help reviewers focus on the real objectives and will be an aid in keeping discussions on track.

The actual conduct of the deliberations are the second critical part of a successful review. These deliberations must be focused on the objective which is a determination of model suitability. For efficiency, all members must participate in all discussions.. The discussions should address related issues such as how the model will be used, who will run it, and what data will be used as inputs. A draft final report should be developed as the discussions progress. It should describe how well the model meets requirements, what means will be used to overcome model deficiencies, or why the deficiencies can be tolerated.

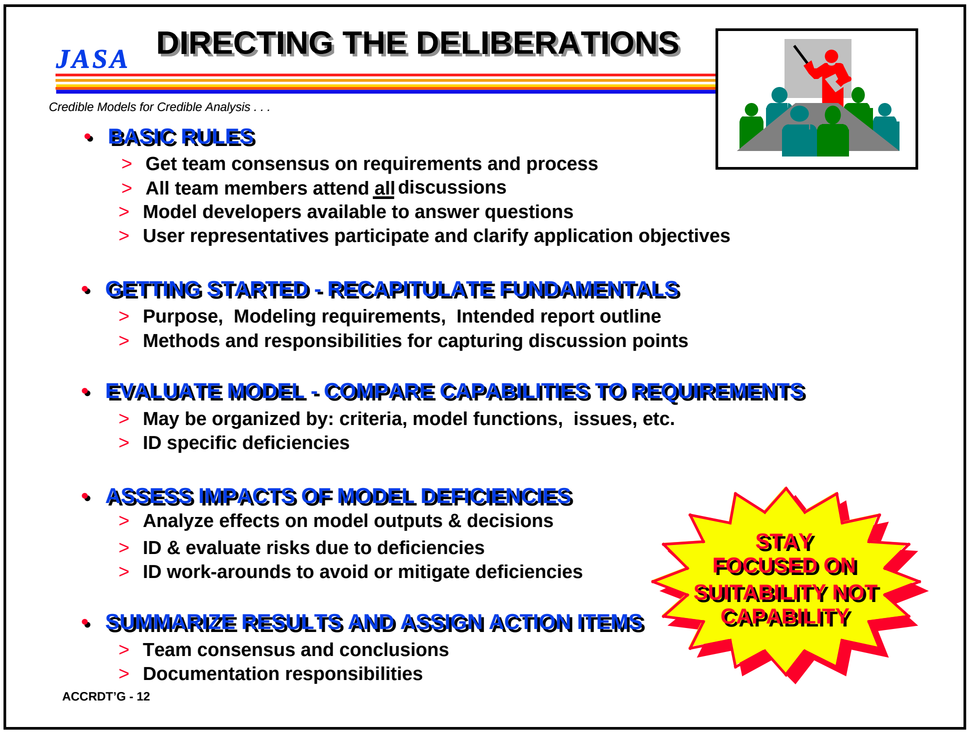
There are three essential elements of a good plan for an accreditation assessment using an expert team: team formation, information collection and distribution to support the review, and a structure for generating a report that satisfies the objectives.

The team's composition should be balanced between application experts, modeling experts, and analysts from the user organization. Representatives from the model developer or anyone who has a vested interest in the model itself should not participate (except to answer questions about M&S details). "Experts" with an alternative agenda should also be excluded. E.g., don't use a competing model developer to serve on the panel. All participants must be given the opportunity to become familiar with the application prior to the actual review. A major consideration in selecting team members is their availability and commitment to the effort.

Team members should be available to help develop and/or review the methods for determining M&S suitability based on the acceptance criteria. They should help determine how the review will be conducted and what questionnaires or scoring techniques that will be used. They should also be encouraged to contribute to the agenda.

Basic information needed for the review includes the acceptance criteria, all V&V data, and possibly results of model runs. An understandable description of how the model functions is essential. Developer briefings can be used, as necessary, to improve model comprehension.

During the review, the discussions must be focused on the objectives, namely how well does the model fulfill the requirements and how any deficiencies will impact the model's use. A well-defined report structure is an invaluable aid in keeping discussions focused. Good planning addresses the issue of how the discussion points will be identified, recorded, and integrated into the report outline for review by the team.



The second key to a productive assessment is an effectively directed meeting. A well-planned agenda that has been coordinated with all the participants helps to minimize orientation discussions and focus attention on the actual evaluation exercise. This includes development of consensus on the modeling requirements and the evaluation process. The team needs to understand what the review objective is, and what products they will be expected to produce. Everyone should agree on the review criteria. All team members should attend all meetings to avoid repetitious discussions. The model developer should attend to clarify and explain model capabilities. The user representatives should be able to clarify questions about requirements.

It is best to start the deliberations by reviewing the requirements, the assessment goals and process, and the questions that must be answered in the final report. Then the functioning of the model should be presented with time for members to pose questions based on their advance readings. The actual assessment is usually done one requirement at a time. The requirement is presented and any shortcomings in model functionality explained. The discussions should focus on the impact of these shortcomings on the application. They should result in some preliminary judgment about model suitability and whether any work-arounds are available for unacceptable deficiencies. It is important that someone is designated to capture the essential points of these discussions and reduce them to writing for later review by the team.

All too often, the team becomes engaged in evaluating the model performance and discussing its weak features and how it can be improved. This type of discussion does little to support an accreditation decision. Team focus must be maintained on the critical issues that relate to the model's utility in this application and how well the model compares to the acceptance criteria.

When the discussions are complete, the draft findings should be reviewed by the team and an overall assessment made about model suitability and risks of using the model as is. Any recommendations for model changes or additional V&V work should be prioritized. A conclusions' summary representing the team's consensus is prepared. The team should review the final draft report sometime after the meetings are complete, ideally within a week to ten days.

JASA TYPICAL DEFICIENCY ANALYSIS QUESTIONS

Credible Models for Credible Analysis . . .

WHAT IMPACT WILL M&S DEFICIENCIES HAVE FROM THE DECISION-MAKERS PERSPECTIVE?

- **EXPECTED EFFECTS OF EACH DEFICIENCY ON MODEL OUTPUT(S)**
  - > **Will model output values be high or low?**
  - > **Will outputs be valid only within a limited range?**
    - » What is range? Will results be high or low outside that range?
- **EXPECTED IMPACTS ON METRICS AND DECISIONS**
  - > **What is likelihood of intolerable model outputs due to each deficiency?**
  - > **What is the impact of false (high or low value) model output?**
  - > **What impact will a model output with a limited validity range have?**
  - > **Ultimately, what is the likelihood of a wrong decision?**
  - > **What are the real-world risks resulting from possible wrong decisions?**
  - > **How much is PM willing to pay to avoid these risks?**
  - > **Can risks be mitigated for this sum?**
- **WORK-AROUNDS**
  - > **What techniques can be used to minimize or bound these impacts?**
  - > **Are there any sources of corroborating information to support a decision?**
  - > **What cautions should be observed when using model outputs in this application?**

ACCRDT'G - 13

In most cases where model deficiencies are identified, the discussion naturally leads to some assessment of whether the deficiency is tolerable. However, in some cases, team members may view a deficiency as being intolerable only because they know there is a better modeling technique that avoids the deficiency. To really assess how the deficiency will impact the model's use in the intended application, one should follow a more structured approach.

The accreditation authority will want to know the M&S deficiencies, how they affect model outputs, and how those outputs will most likely impact the expected problem decisions or outcomes. An analysis of the deficiencies' impact should first determine if model outputs will be biased high or low (or if the expected variation is unknown). The analysis should also address whether these expected biases are valid for some or all input data values. Finally, some assessment should be made as to the utility of the model outputs considering all the risks and restrictions placed on its use.

Recognizing that no model is perfect; the accreditation authority will want to know what risks can be expected if the recommended model is used and what caveats or restrictions should be placed on model usage. Any actions or steps that can be taken to mitigate the impact of model weakness should be examined as well. Manual adjustments of input or output values or changes to functional parameters within the model may often compensate for model deficiencies and preserve the ability to use a particular model that has some deficiencies. Other work-arounds may include limiting the model's use to certain scenarios where the outputs are known to be acceptable.

JASA **OTHER ACCREDITATION CONSIDERATIONS**

Credible Models for Credible Analysis . . .

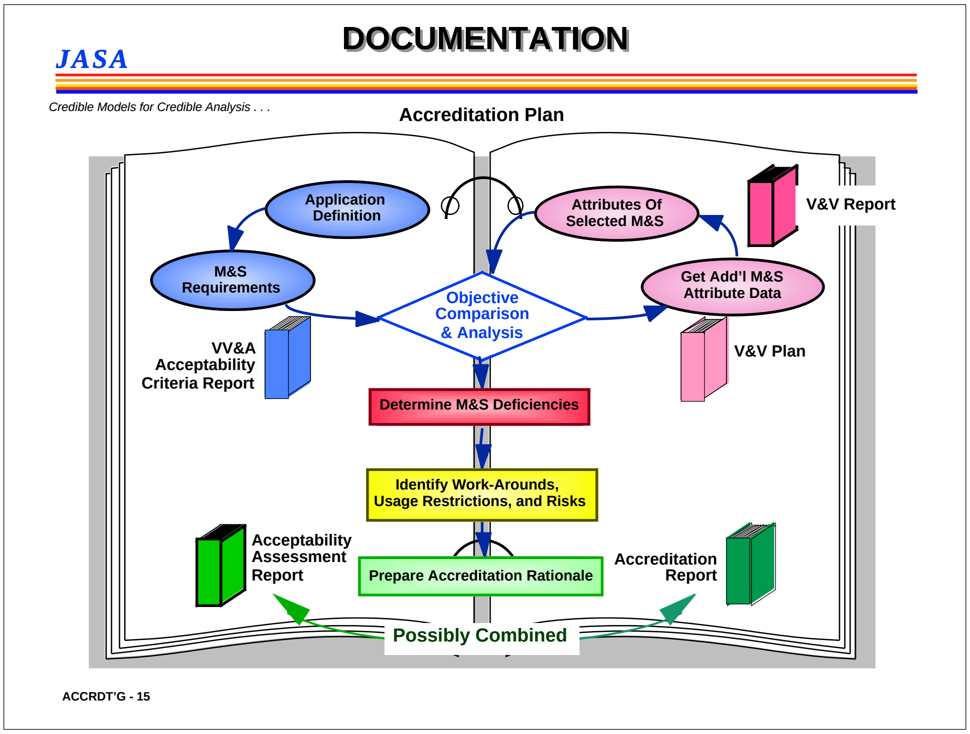
- **WHO IS THE "ACCREDITATION AUTHORITY"**
  - > **IN GENERAL TERMS - THE AUTHORITY WHO MUST DEFEND THE DECISION MADE BASED ON MODEL OUTPUTS**
- **KNOWLEDGE NEEDED BY ACCREDITATION AUTHORITY**
  - > **CLEAR UNDERSTANDING OF:**
    - » Broad picture
    - » Program goals, objectives, constraints, thresholds
  - > **BASIC AWARENESS OF:**
    - » M&S concepts, scenarios, requirements
    - » Analytical techniques, Data sources, etc.
    - » Need for V&V
    - » VV&A policies and guidance
- **DATA VV&C REQUIREMENTS**
  - > **CHECK LATEST DMSO GUIDANCE**

ACCRDT'G - 14

Once the accreditation assessment team has produced an assessment report, the final step in the accreditation process is obtaining the approval of the accreditation authority. The service directives identify who is the accreditation authority. For major M&S or analyses supporting major programs the accreditation authority is the official who is responsible for the decision(s) made based on the model outputs. This is generally a senior official who may not be familiar with the details of model data, functions, or outputs. To make a sound accreditation decision, the accreditation official must understand the "big picture" along with application goals, constraints, and decision thresholds. This official should be aware of why M&S are being used, other analytic or non-M&S sources of decision support data, the scenarios and concepts that are being used in the M&S analysis, and the top level guidance concerning M&S management and usage.

The expecteddegree of knowledge and understanding of the accreditation authority results in two dictums that should be observed by the accreditation and V&V agents. First the M&S requirements and the accreditation rationale should be stated in programmatic or operational terms. Second the V&V results should be analyzed to determine the impacts on M&S usage. An example of a poorly worded result might be: "the model incorrectly averages the results or both PRFs." A better statement would be: "Incorrect PRF averaging leads to an erroneously high value for clutter predictions. This error causes the model predictions of acquisition range to be too low and thus understates weapon performance predictions."

A final concern of the accreditation authority is the validity of the input data used in the model. Accreditation will necessitate some type of data VV&C. Some additional guidance is expected from DMSO on VV&C procedures. When these procedures are promulgated, the role of the model assessment team may be expanded to include data validity assessments.

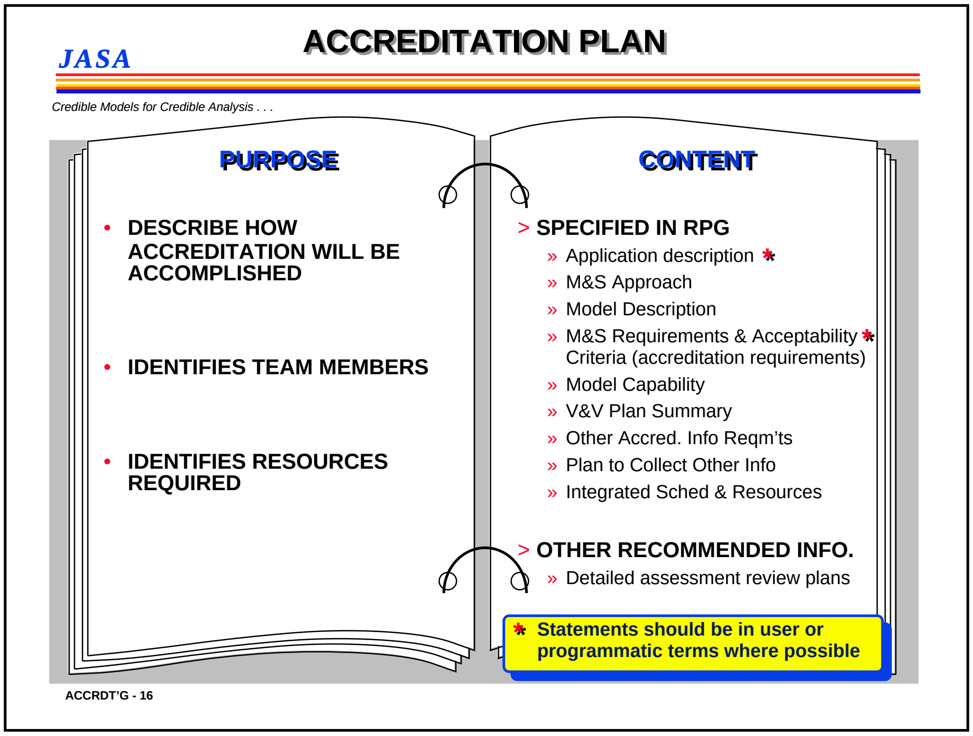


An important element of the entire accreditation process is the documentation. The DMSO RPG lists a number of documents that are normally used and outlines the information content for them. This chart shows the relationship of these documents to the overall accreditation process which itself is documented in the accreditation plan.

The VV&A Acceptability Criteria report is merely a description of the problem and the associated modeling requirements. This document is the basis for the comparisons that are to be made. According to the RPG guidance, the information in this document is repeated in subsequent documents. Since the RPG only provides "recommendations", users may choose to combine this document with the accreditation plan or, alternatively, reference this report in the accreditation plan rather than repeating the information.

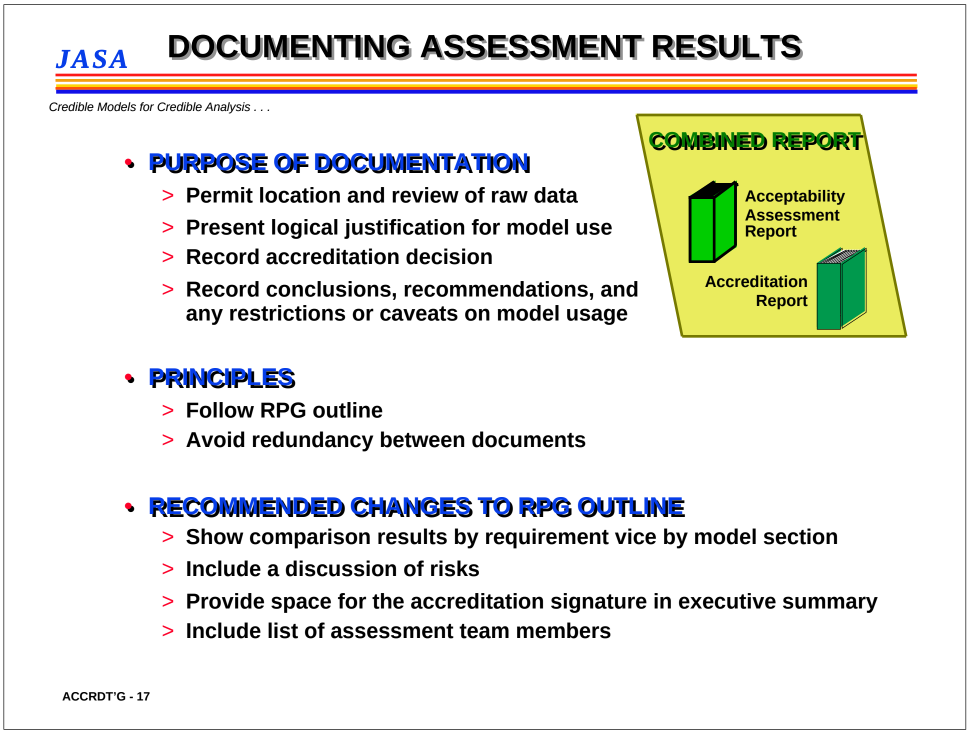
After the initial compariso between modeling requirements and model capabilities, if additional V&V is required, the V&V plan outlines what is needed and lays out the plans for accomplishing the necessary tasks. V&V reports are generated to record the results of this supplemental work.

After the final assessment of the model is complete, an Acceptability Assessment Report documents the results of that assessment. That report is used by the accreditation authority to make the decision which is then documented in the Accreditation report. The outlines for these two reports are complimentary and, in many cases, can be combined into one report. A single report is often more practical since the accreditation authority seldom will have time to prepare a separate report.



The accreditation plan records the decisions and results of the accreditation planning effort. It addresses the plans for performing the initial assessment, for addressing any deficiencies uncovered in that assessment, for performing the final assessment, for obtaining any reviews and endorsements that may be required, and for obtaining final accreditation approval. It identifies all team members or describes how team members will be selected. It further identifies all resources needed to accomplish each of the tasks and outlines who will provide them.

The minimum essential information that should be documented in the plan is identified here and is further described in the RPG. Much of the information called for in this plan may not be available in detail when the plan is first written. Therefore, only as much detail as is available need be included. As additional details are developed during the course of the VV&A activities, they are used to update this plan or are included in subsequent plans (e.g. V&V plan) or reports (e.g. accreditation assessment report). Besides the information called out in the RPG, the accreditation plan should also describe plans for conducting the necessary assessment reviews

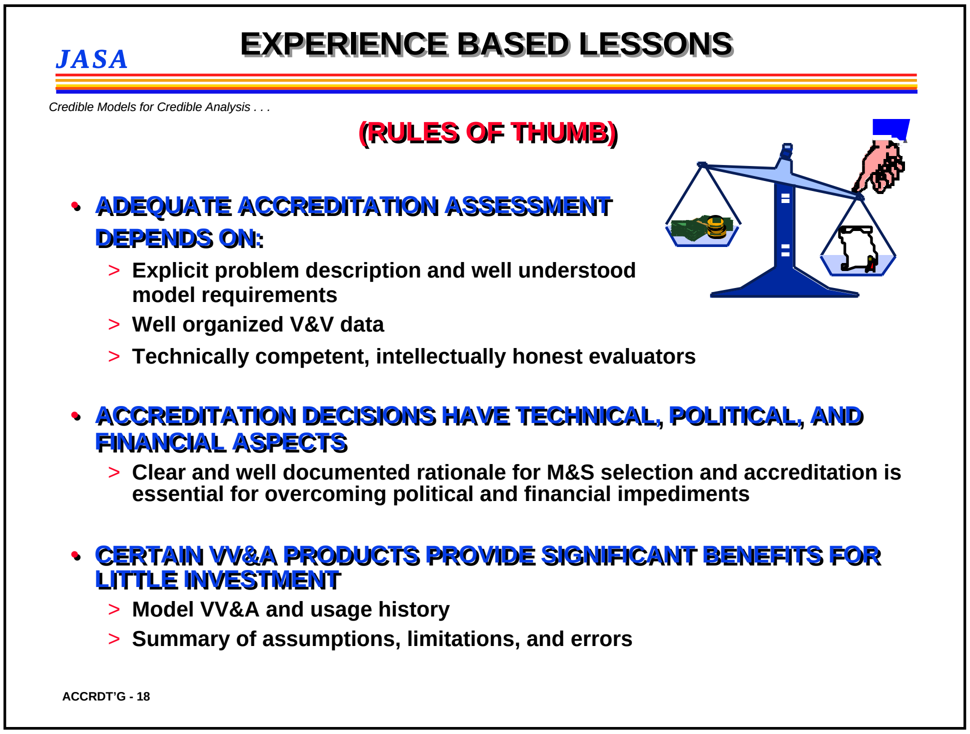


The purpose of this documentation, which is a combined accreditation assessment report and an accreditation report, is to record the final decision and to present the logical justification for that decision in a clear and understandable manner while minimizing the amount of paper and material the reader must wade through. The assessment results, along with any recommended restrictions or caveats affecting model usage should be recorded in user terms so that the logic is clearly evident and understandable to the user. Finally, conclusions and recommendations should be clearly identified.

Ideally, the documents should follow the outline presented in the RPG. However, the outlines indicate significant redundancy between various plans and reports. Wherever possible, authors should avoid redundancy, e.g. material contained in the accreditation plan should only be summarized in the accreditation report with appropriate references to the plan.. One recommended change to the RPG suggested outline is that the results of the accreditation assessment review should be presented by requirement vice by model section. This organization is more typically how the assessment will be organized and helps ensure that all requirements are addressed. In addition, all risks, caveats, and work-arounds should be spelled out and fully explained (i.e. why they are acceptable, and/or how they will be controlled or mitigated).

The executive summary, which should be no more than 2 pages, should contain the essence of each of these sections along with a list of all the conclusions and a space for the accreditation authorities signature.

With this format, the accreditation authority will have a logical and clearly presented justification of the model's suitability for the desired application. This document will be the primary evidence to support M&S credibility during subsequent program reviews where challenges to the M&S outputs might be expected



The important lessons of the foregoing discussion on accreditation can be summarized in a few rules of thumb. First, a believable accreditation assessment requires three prerequisites: a clear set of modeling requirements, well organized information about the model so that a comparison can be made against the modeling requirements, and a technically-competent evaluator(s) who can make an honest, unbiased evaluation of the model's suitability. These three elements are essential to any worthwhile accreditation effort.

The second rule of thumb is that accreditation decisions cannot be made solely on a technical basis. There are political and financial factors that drive these decisions. To prevent the political and financial factors from being the only basis for accreditation, it is necessary to document the technical requirements and rationale in clear, understandable terms that highlight impacts of violating the technical requirements.

The third rule of thumb, which became apparent through experience, is that certain types of information have significant value in making the accreditation assessment. The most valuable types of information are a good description of the model, a complete history of the model's usage (including a post-use report of the model's suitability for each use), and a complete list of assumptions, limitations, and errors that are known based on developer's documentation and all V&V work that has been accomplished. (Any model anomaly uncovered through V&V can be translated into an assumption, limitation, or error.)

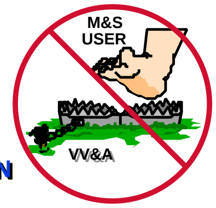
These three rules of thumb should be remembered and incorporated in the planning for any VV&A effort.

JASA

EXPERIENCE BASED LESSONS

Credible Models for Credible Analysis . . .

(AVOIDING TYPICAL TRAPS)



- **A NEW ACCREDITATION ASSESSMENT IS NEEDED FOR EACH APPLICATION**
  > "VV&A" is not a one-time check-in-the-box that satisfies all users
- **M&S USERS AND ANALYSTS MUST PARTICIPATE IN DEFINING REQUIREMENTS**
  > Produces complete and comprehensive requirements
  > Makes them understandable to reviewers
  > Leads to better discussions of M&S suitability
- **ACCREDITATION ASSESSMENT TEAMS MUST PARTICIPATE IN PLANNING THE REVIEW**
  > Ensures a clear understanding of application requirements
  > Builds consensus and acceptance of review process
  > Aids in disciplined and focused meetings
  > Ensures their availability for documenting the results

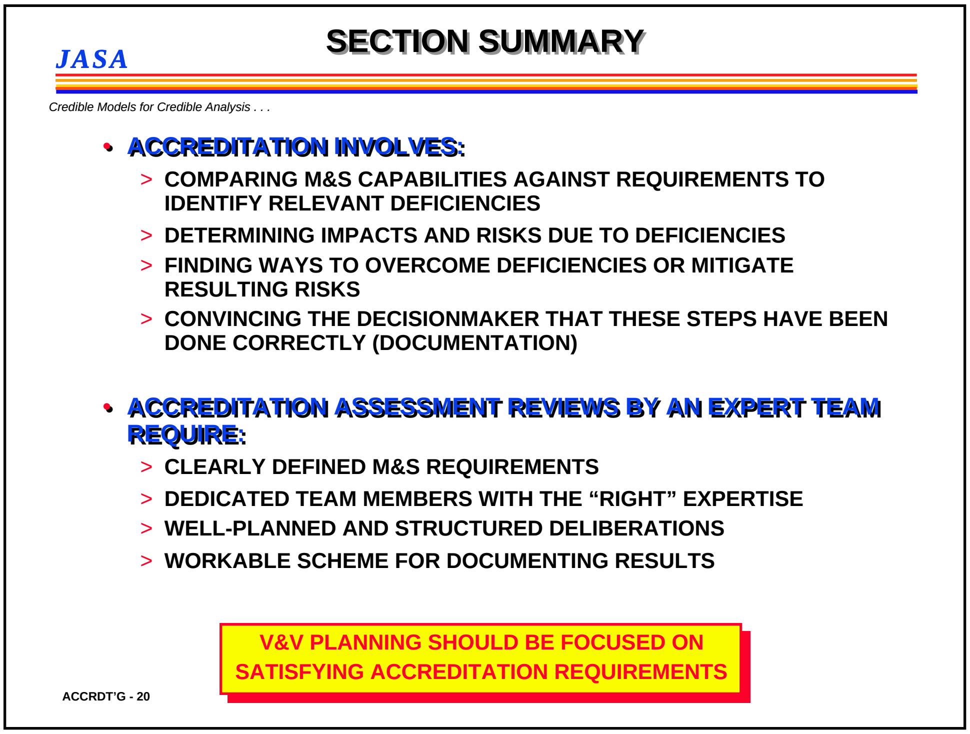
ACCRDT'G - 19

Based on observations of several VV&A efforts, a number of common mistakes & misperceptions have become apparent. If not corrected or avoided, these misperceptions can lead to improper or totally inadequate accreditation efforts that only waste resources without making any valid determination of model suitability.

The first common mistake is that a prior accreditation decision makes the model suitable for any subsequent use. This is totally untrue. Although a model may be suitable for one use, it may have significant limitations that make it unsuitable for another use. Accreditation is required each time the model is used in a new application. Only for applications that are very similar to a previous one where accreditation was granted, can the previous accreditation be considered valid.

Another common mistake is to "contract out" the development of modeling requirements. Such a practice leads to incomplete requirements definition. Only the users and the analysts who will be running the model and who understand the problem can define all the modeling requirements. In addition, they tend to state the requirements in terms that are understandable to the typical assessment team members, thus leading to better assessments.

Finally, the accreditation assessment teams must participate in planning the assessment reviews. Without team buy-in to the requirements and the process, a lot of time will be wasted in discussing preliminaries, leading to insufficient time on actual model assessments. More time for the real assessments will lead to more complete assessments and better conclusions and recommendations. This is the heart of the accreditation assessment report that provides the rationale for a defensible accreditation decision.

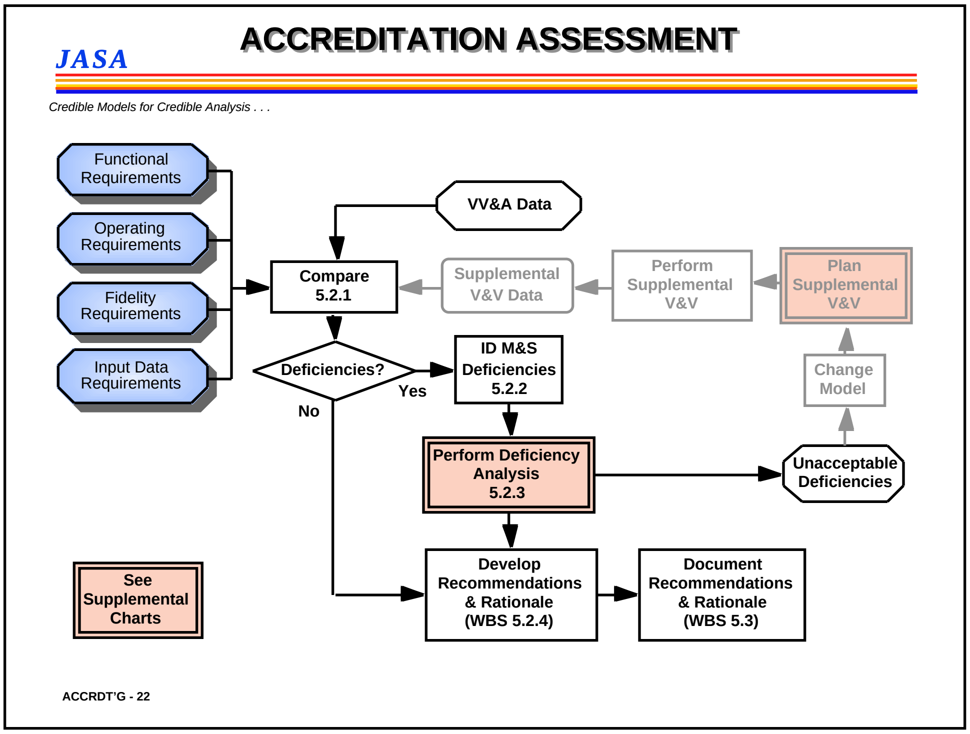


In summary, accreditation is merely a comparison of a set of requirements with a models capabilities and limitations. Any deficiencies that are found from this comparison must be analyzed to assess the effects on the ultimate decision or action which underlies the purpose for using the model. If possible and cost-effective, work-arounds or ways to mitigate any deficiencies should be used instead of model changes. The accreditation rationale and decision considers not only the model’s capabilities but also the work-arounds and mitigating factors. This rationale must be documented in a way the convinces the accreditation authority that the whole process is valid and the justification exists to defend the accreditation decision in subsequent program reviews.

Accreditation reviews are best done by a team of experts when the model or application is complex or when explicit criteria cannot be developed (e.g. a COEA for a countermeasures system that is meant to counter a threat about which there is little technical information). A successful review requires that the modeling requirements be clearly stated and well understood. Furthermore, the team members must understand both the model and the requirements that are derived from the application. They must have the time to fully participate in the reviews and report preparation. Effective reviews require good planning and prior buy-in to the process by all team members. Finally, there must be a viable means of capturing the essential points of all the review deliberations and documenting them in a draft report that can be reviewed by the team.

Throughout the entire VV&A evolution it is essential to remember that accreditation is the goal. All V&V efforts should be focused on providing information that is useful in making the accreditation assessment. Without this focus, valuable resources can be wasted on extraneous V&V work.

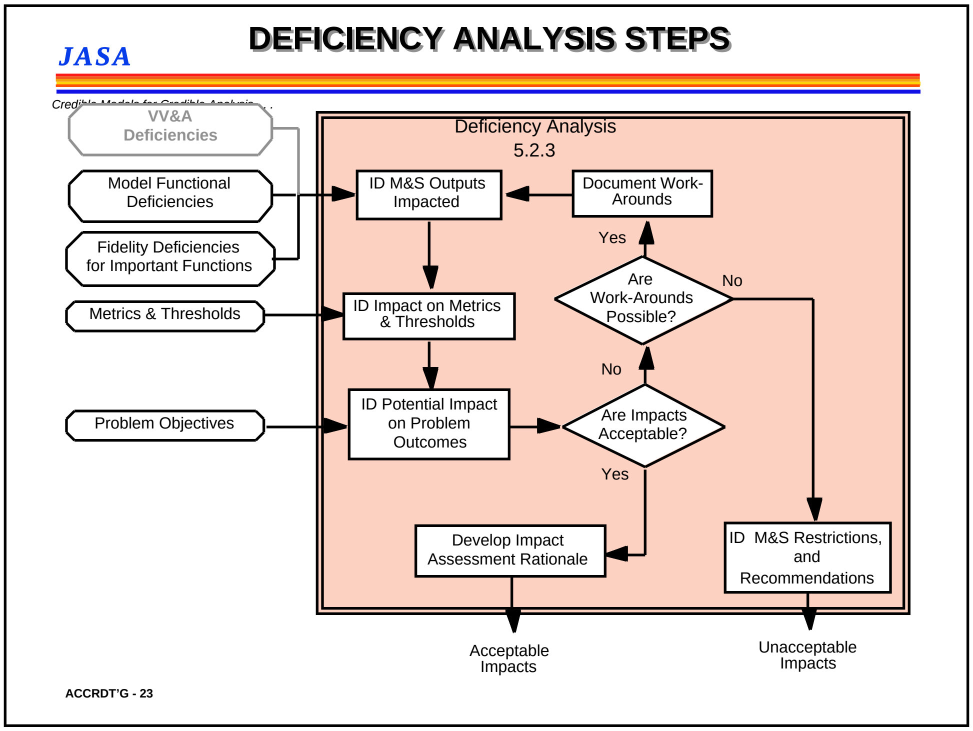
ACCREDITATION ASSESSMENT SUPPLEMENTARY CHARTS



The actual accreditation assessment logical process is diagrammed here. The starting point is the comparison of the modeling requirements with the data on the model's capabilities and attributes. This comparison may be fairly simple if the modeling requirements are clearly and unambiguously specified. If not, the comparison may be more complex and may require a team of experts to render judgment. The issues related to using an expert team will be discussed later.

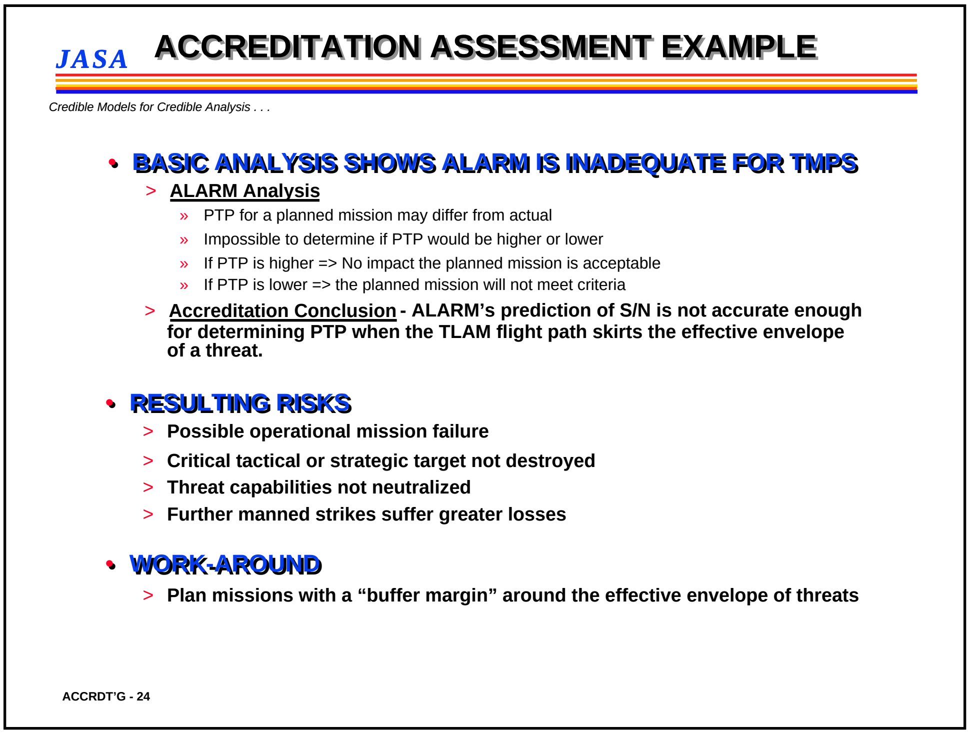
If no deficiencies are identified as a result of this comparison, the recommendations and rationale for accreditation are easily developed and documented. If some deficiencies are identified, an impact analysis is required for each deficiency. If suitable work-arounds are found and/or the impacts are endurable, the recommendations and rationale are prepared and documented. In this case the rationale must include a discussion of the impacts and work-arounds. If the impact analysis proves that the model is unacceptable, a recommendation to not accredit can be justified.

In practical terms, a non-accreditation decision is seldom practical and unacceptable models are generally modified. Therefore, the modification process is shown here although it is technically not a part of the accreditation process. The purpose of showing it is to point out that any model changes lead to additional V&V requirements for the changed portions of the model before final a accreditation can be done.



The impact analysis for any model deficiencies can be described by this flow chart which is similar to the one shown in the planning section. Any functional or fidelity deficiencies in a model are related to potential errors or biases in model outputs. Using the relationships of model outputs to MOEs and COIs (Critical Operational Issues) to the ultimate decision(s), one can judge how the model deficiencies are likely to affect the ultimate decision(s). If there are any viable work-arounds that would negate or mitigate these effects, they should be identified and the effects of the work-around analyzed.

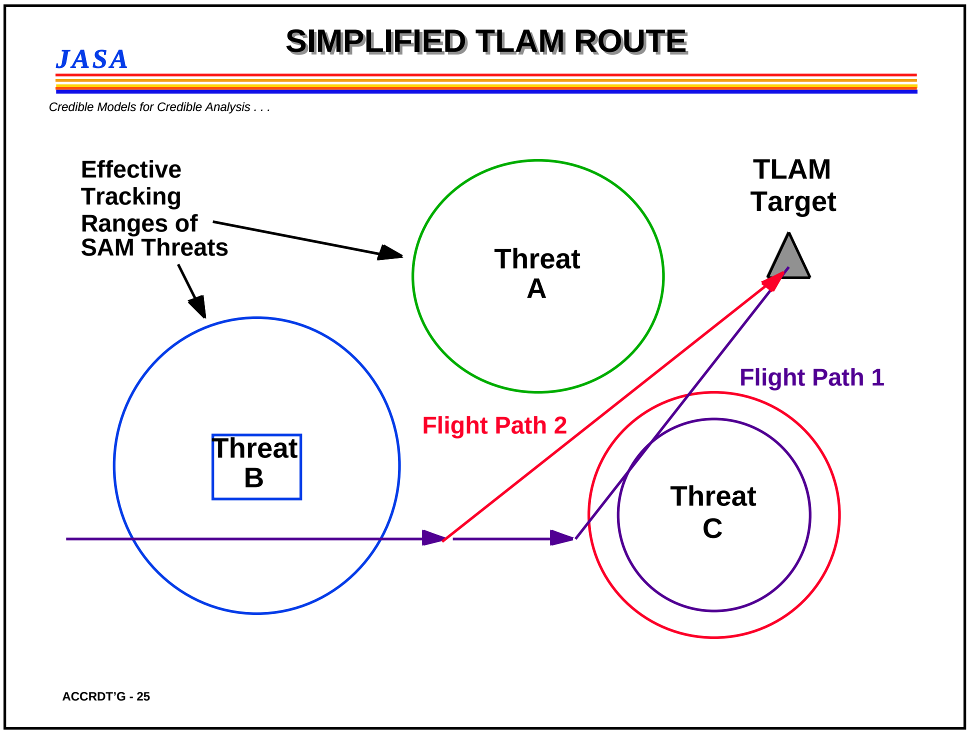
Risks are related to two aspects of this process: first the risk that the model deficiency will actually affect the decision and second the risks that might result from an incorrect decision. The first risk can be stated as a likelihood that an incorrect decision might be made. In some cases that risk might be lessened or increased if the input conditions exceed certain values. These then become boundaries on the risks. The risks that can result from incorrect decisions were discussed in relation to identifying V&V steps. If these risks are significant, they serve as rationale to support funding for model changes.



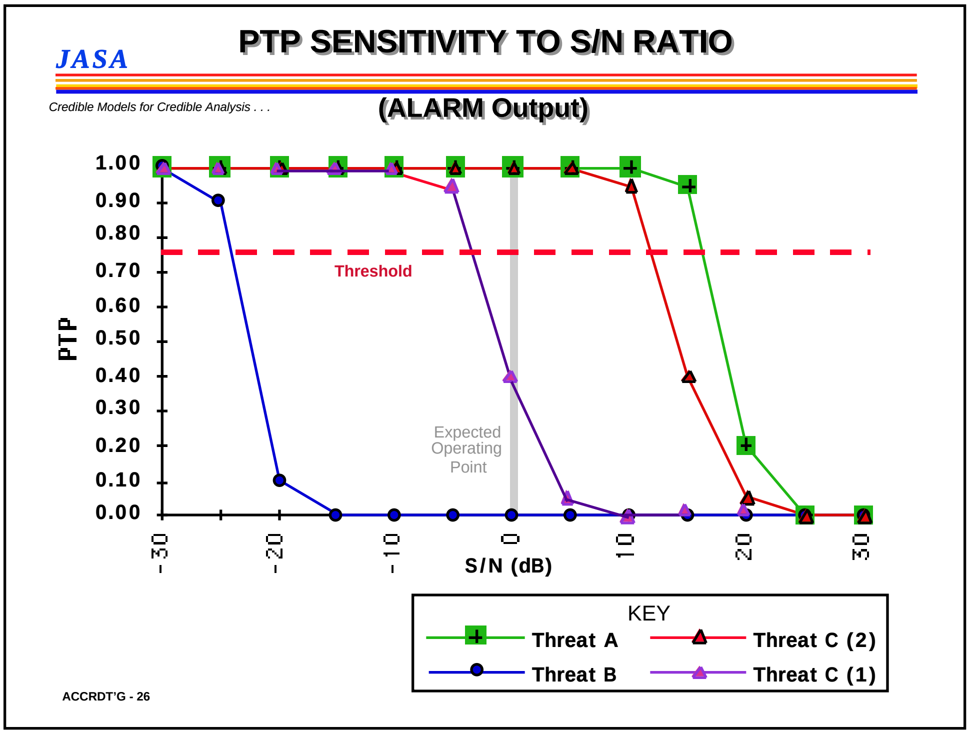
The comparison process that is the heart of the accreditation assessment was discussed in theory. To put this discussion in perspective we can look at an actual example of an accreditation assessment for the Tomahawk Mission Planning System discussed previously.

Recall in that example that the ALARM fidelity requirements for signal-to-noise ratio predictions were less than 1% under the most stringent conditions (i.e. when a missile skirted the effective envelope of a threat site). ALARM does not predict S/N with that degree of accuracy and there is no way to determine if the ALARM predictions are biased either high or low. As a consequence, if the ALARM predictions are used, a truly acceptable mission might be rejected or an unacceptable mission might be used. This latter case has greater consequences since the missile would have less likelihood of reaching its designated target.

In this Tomahawk planning problem, a simple work-around is to use a buffer region around all threats when planning the Tomahawk route. The size of the buffer region could be determined based on the expected accuracy of the ALARM predictions. With this work-around the PTP prediction for a mission that was planned using these buffers would err on the conservative side (i.e., predicted PTP would be the same as would really be expected if the model predictions were perfectly accurate and the flight path did not adjust for these buffer regions).



The work-around discussed in the previous chart is depicted here. If the TLAM follows flight path 1 it skirts the effective envelope of site C. To accurately predict PTP the ALARM prediction of S/N must be very accurate. If the flight path is changed to #2 the PTP can be realistically predicted even though the S/N predictions may have some errors.



This chart shows the variation of PTP with S/N for all threats in the previous chart. Note that the curve for threat C and flight path 1 is centered at the 0dB point. What this means is that a slight variation in S/N will change PTP significantly. This observation is consistent with the previous chart where the flight path is tangent to the effective range circle. A slight change in the S/N ratio would move the circle either in or out thus causing a significant change in the effectiveness of that weapon against the TLAM.

The work-around of adding a buffer zone effectively shifts the curve C(1) to the right into the position shown as C(2).